Spring 2021

ME 316-102: Machine Design

Trivikrama Pala

Spring 2021: January 19, 2021 - May 11, 2021

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ME316 Design of Machine Elements Prof. Trivikrama Pala

Guidelines for Design Project Report

Two possible design projects are #9-11 and #9-13 in your course text. Each team of 2 students undertake one of these design projects. Although you are preparing a formal report, you can assume a more familiar tone as if you are addressing your colleagues. You may be free in style but remain rigorous in language. If you use any source in your report, it must be properly and fully referenced.

The report must address all of the following (but is not limited to):

- Analysis of all functional requirements of the product
- Consideration of various preliminary design options (possible solutions)
- Detailed analysis of engineering performance; e.g. stress, deflection, stability (buckling etc.), fatigue, wear, power requirements, strength of joints (Welds, bolts, screws, rivets, adhesives, etc.). It is expected that both analytical methods and FEA will be used.
- Preliminary analysis of human factors
- Consideration of manufacturing methods and materials for custom components and overall assembly of the final product
- Details of off-the-shelf components to be used
- Approximate cost estimate

PROJECT DATES

Registration of project: **Feb 02 2021 by 6:00 PM** (late penalty 2% per day) *Final Report Due:*

April 20th, 2021 by 6:00 PM (late penalty 10 % per day)

FORMAT: 1 cover page + 12 double or 1.5 spaced pages (max.) including figures/diagrams

- It is unnecessary to include all equations and calculations associated with your analyses. Provide only enough equations and intermediate results to allow a technically literate reader to follow your approach and understand the assumptions and limitations of your modeling.
- Equations and calculations should be summarized in an appendix that should be included in the 12 pages.
- Each student must identify the sections they wrote

TOTAL MARKS: 20 marks (3 for overall quality, 17 for each student's sections)

Each student will receive a mark for their section(s), which must be clearly identified by initials in the heading to that sections (e.g. "Analysis of shaft (S.N.)" if I had written that section). Therefore, it would be wise to have a clear understanding at the outset of which parts are to be accomplished by which member. *Of the 17 marks for individual effort, 12 will be for technical content and 5 for the quality of the writing (grammar, spelling, English usage, concise writing)*

DIAGRAMS: All diagrams must be clearly drawn with parts labeled and a proper title and figure number.

- Line drawings are often superior to photographs. However, if you decide to use photographs, ensure that they are well composed and illuminated (on a neutral background and without clutter) and in focus.
- Do not assume that the time spent in rendering an object in a CAD program is better than a good sketch. The purpose of the drawing is to enhance the reader's understanding.
- All drawings should be referred to in the text of the report.
- Ensure you describe, orient, and explain to the reader what is being conveyed.
- All drawings copied from a published source should be fully referenced on the drawing page.

EXAMPLE REPORT STRUCTURE

Introduction

- Purpose of the machine (use, production volume, cost)
- Functional requirements of the product/machine

Design Option Considerations

- Brainstorming process
- Final design option selection (why this design?)

Engineering Analysis

- Operating principles and explanations of design rationale
- Analysis of loads, stress, deflection, fatigue, wear, fracture, etc. (with free-body diagrams) –see introduction paragraph in this guideline for other required information use analytical methods and FEA
- Probable manufacturing methods and materials
- Details of off-the-shelf components to be used
- Assembly drawing with BOM and Cost Analysis

Conclusions

- Overall assessment of your "machine design"
- Possible improvements/modifications
- Cost estimate

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ME 316 Machine Design Spring Session January 19 - May 11 ,2021

Delivery Mode - Online

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OUTLINE

Required Text: Machine Design, 5th edition, Robert L. Norton, Pearson Prentice Hall 2014

Grading:
Exam 1 20%, Mar 02, 2021
Exam 2 20%, May 11, 2021
Home Work & Attendance 5%,
These dates are tentative and will be confirmed
Project 20%
Final Exam 35%

Permitted aids on exams: Course text and non-programmable calculators only

Design Project

You and your partner will undertake a detailed engineering design of a specified product (either problem #9-11 or #9-13. This will include:

- analysis of all functional requirement of the product
- consideration of various preliminary design options (possible solutions)
- detailed analysis of engineering performance (analytical and FEA); e.g. stress, deflection, stability (buckling etc.), fatigue, strength of joints (welds, bolts, screws, rivets, adhesives etc.)
- preliminary proposal of manufacturing methods and materials for custom components and overall assembly of the final product
- details of off-the-shelf components to be used
- cost estimate

Project dates: Registration of project: **Feb 2nd, 2021 by 6:00PM** (Late penalty 2% per day). Register by sending me an email with the names and email addresses of four team members and the design topic. **Final report due on April 20th, 2021 at 6 PM** (late penalty 10%per day).

Make sure you discuss your plans and project progress with me regularly by emails and after the class hours.

Grading Scale: A if the average is 90% or above and Fail if the average is below 60%. The breakdown of the grades between A and F will be decided at the end of the semester.

Prerequisites: ME 215 Materials and Processes, ME231 Kinematics of Machinery and ME315 Stress Analysis

How to get a good grade:

Work on the assignment problems given corresponding to each lecture. Try them first on your own. Keep up with the lectures and ask me for help after the lecture class hours– don't let your questions pile up. It's a good idea to read carefully the sections of the text that complement or correspond to the lectures. The exams may refer to general information provided during the lectures but not found in the text. Attending the lectures will make it much easier for you understand the problems and focus on the most important material. Read the project report guideline for producing a proper design report.

Reading Assignment
To follow along with the lectures, it is recommended that you read: Ch.1 Sections 1.3-1.6, 1.10 and Ch.2 Sections 2.2-2.8. This material will also be covered in the exams.

Tentative Schedule for ME 316 Machine Design Spring 2021 Jan 19 - May 11, 2021

Week	Topic	Date
1	Ch.3. Kinematics and Load Determination and Ch. 4	Jan 19, 2021
2	Ch.4 Stress, Strain	Jan 26, 2021
3	Ch.4 Deflections	Feb 02, 2021
4	Ch.5 Static Failure Theories	Feb 09, 2021
5	Ch.6 Fatigue Failure Theories.	Feb 16, 2021
6	Ch.6 Fatigue Failure Theories Cont I	Feb 23, 2021
7	**Exam 1;**Ch. 6 Fatigue Cont. II	**Mar 02, 2021**
8	Ch.10 Shafts Keys and Couplings	Mar 16, 2021
9	Ch.11 Bearings and Lubrication	Mar 23, 2021
10	Ch. 7 Surface Failure	Mar 30, 2021
11	**Exam 2** Ch.7 Surface FailureI	**April 06, 2021**
12	Ch.7 Suraface Failure II ; Ch.15 Screws and Fasteners	April 13, 2021
13	Ch.12 Spur Gears Ch. 14 Spring Design	April 20, 2021
14	Ch. 17 Clutches and Brakes; Ch.16 Weldments	April 27, 2021
15	**Final Exam**	**May 11, 2021**

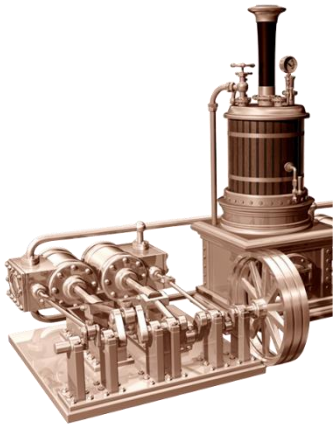

Image of an old steam engine obtained from www.asme.org
It shows some of the important components of machines. In this course, you will learn how to design such components.

NOTE: All the above items may be subject to change as per instructor's discretion. (For example, the Grading Scale may be adjusted to reflect the class average.)

Home Work	Problems
1	Ch. 1 and Ch.2 reading 2-1,2-4,2-5,2-13,2-15 3-1, 3-4, 3-5, 3-10, 3-17
2	3-7,3-8, 3-11, 3-15, 3-21,3-22, 4-3, 4-4, 4-7, 4-8,4-17,4-18, 4-19, 4-21, 4-22, 4-30a, 4-53, 4-67
3	5-1a,c,e, and j 5-3, 5-4, 5-7, 5-8, 5-10, 5-11, 5-17, 5-22, 5-49, 5-54
4	6-1b, c, and h, 6-2b, 6-3, 6-4a, 6-5a, 6-7, 6-20, 6-33a, 6-37,6-54, 6-55, 6-56, 6-57
5	6-19, 6-30, 6-34a, 6-38, 6-42
6	10-1a, 10-9a, 10-11a, 10-31a.
7	11-1,7a,7-2, 7-7, 7-13, 7-14, 7-16, 7-19, 7-24, 7-30